



THE GEORGE  
WASHINGTON  
UNIVERSITY

WASHINGTON, DC

REGRESSIONS DATA  
ANALYSIS PROJECT  
EMSE 4765/6765  
SPRING 2024

Perform the data analyses and answer the questions below in a data analysis report no later than **April 30th, 2024**. You may not work together on this assignment and you should perform your analysis and write the report on your own.

**Please provide me with your electronic files and a PDF FILE OF YOUR WRITTEN REPORT UPLOADED ON BLACKBOARD, and a hard copy of your report detailing your analysis steps and conclusions.**

## Regression Project:

Satellite applications motivated the development of a silver-zinc battery. The Table below (provided in the file "battery.xls") contains failure data collected to characterize the performance of the battery during its life cycle.

| Charge Rate<br>(Amps) | Discharge<br>Rate (Amps) | Depth of<br>Discharge<br>(% of rated<br>ampere-<br>hours) | Temperature<br>(Celcius) | End of<br>charge<br>(Volts) | Cycles to<br>Failure |
|-----------------------|--------------------------|---|--------------------------|-----------------------------|----------------------|
| X1                    | X2                       | X3  | X4                       | X5                          | Y                    |
| 0.375                 | 3.13                     | 60  | 40                       | 2                           | 101                  |
| 1                     | 3.13                     | 76.8  | 30                       | 1.99                        | 141                  |
| 1                     | 3.13                     | 60  | 20                       | 2                           | 96                   |
| 1                     | 3.13                     | 60  | 20                       | 1.98                        | 125                  |
| 1.625                 | 3.13                     | 43.2  | 10                       | 2.01                        | 43                   |
| 1.625                 | 3.13                     | 60  | 20                       | 2                           | 16                   |
| 1.625                 | 3.13                     | 60  | 20                       | 2.02                        | 188                  |
| 0.375                 | 5                        | 76.8  | 10                       | 2.01                        | 10                   |
| 1                     | 5                        | 43.2  | 10                       | 1.99                        | 3                    |
| 1                     | 5                        | 43.2  | 30                       | 2.01                        | 386                  |
| 1                     | 5                        | 100   | 20                       | 2                           | 45                   |
| 1.625                 | 5                        | 76.8  | 10                       | 1.99                        | 2                    |
| 0.375                 | 1.25                     | 76.8  | 10                       | 2.01                        | 76                   |
| 1                     | 1.25                     | 43.2  | 10                       | 1.99                        | 78                   |
| 1                     | 1.25                     | 76.8  | 30                       | 2                           | 160                  |
| 1                     | 1.25                     | 60  | 0                        | 2                           | 3                    |
| 1.625                 | 1.25                     | 43.2  | 30                       | 1.99                        | 216                  |
| 1.625                 | 1.25                     | 60  | 20                       | 2                           | 73                   |
| 0.375                 | 3.13                     | 76.8  | 30                       | 1.99                        | 314                  |
| 0.375                 | 3.13                     | 60  | 20                       | 2                           | 170                  |

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Denoting the cycles to failure  $Y$ , please address the following questions below in your written report.

- a. Perform an analysis of  $Y$  and  $\text{Log}(Y)$  and motivate which one of these two should be chosen as the dependent variable.
- b. Find the estimated linear regression of  $\text{Log}(Y)$  or  $Y$  (depending on your choice under a.) on an appropriate set of explanatory variables  $X_1, \dots, X_5$  using the 20 joint observations of the explanatory variables and interpret the results. Motivate your model development in your report as per the techniques described in the lecture notes on regression analysis. **One is not to use the best subset regression or stepwise regressions procedure in motivating the steps leading to your final selected regression model.**
- c. Perform and detail a diagnostic analysis in your report as per the techniques described in the lecture notes on the regression analysis of your final selected model chosen in Part b.
- d. Forecast the cycles to failure for the following values of the independent variables and provide a 95% confidence interval and 95% prediction interval:

$$x_1 = 1.500, x_2 = 4.5, x_3 = 50, x_4 = 25, x_5 = 2$$